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October 3, 1990

KF

Ash Grove Cement West, Inc.
6720 S.W. Macadam Ave., Suite 300
Portland, Oregon 97219-2312

Attn: Richard Cooke, Vice President

Re: Ash Grove Cement West, Inc. Proposed Drywell System

Dear Mr. Cooke:

This letter presents our findings relative to the above subject project. The intent of this report is to summarize the results of our analysis and to provide recommendations to be used during construction of this project.

PROJECT BACKGROUND

The Ash Grove Cement Plant is located between East Marginal Way South and the Duwamish Waterway, in South Seattle, Washington. (The City address at the plant is: 3801 East Marginal Way South)

Currently, stormwater runoff generated at this facility is routed over the surface and through a piping system to a holding pond located adjacent to the east bank of the Duwamish Waterway.

The stormwater entering this pond exhibits a higher than normal pH level due to suspended solids which enter the conveyance system from various non-point sources throughout the plant. An additional water quality concern includes discharge from truck wash operations into the drainage system. Runoff associated with this latter activity is routed through sediment-removal facilities before the flows are directed toward the pond. Water collected in the pond is further treated through the addition of pH-neutralizing agents.

The collected water is detained in this pond before slowly seeping into the adjacent sandy soils and out of the pond. While the close proximity of the Duwamish Waterway and associated fluctuating tide levels apparently exert a definite influence on ground water levels elsewhere on the site (see RZA report), tidal influence is minimal in the pond vicinity. This can possibly be attributed to the buildup of sediment fines which have accumulated on the sides-bottom of the pond and have restricted outflows.

Ash Grove plans to put the area in the vicinity of the pond to use and intends to fill the existing pond with crushed rock material. Thus, the function of the existing pond area will be to serve as a "drywell" below ground and provide usable space for parking or storage of bulk materials above ground.

The primary aim of this study, then, is to determine the practicality of transferring above-ground storage within the existing pond area into comparable subsurface storage.

SITE CONDITIONS

Existing site conditions were evaluated using a topographic map prepared by Smith & Monroe & Gray Engineers, Inc., in November of 1988. As such, existing pond volumes are approximate extrapolated values derived from indicated map configurations. Soils data were obtained from three soils reports prepared by Rittenhouse-Zeman & Assoc. of Bellevue, Washington between 1988-1990.

Our analysis of on-site drainage characteristics was based in part on topographic information provided by Smith & Monroe & Gray, as well as a previous hydrologic analysis performed by Meriweather Leechman Associates, Inc. (MLA) in 1989 for the Washington Department of Ecology discharge permit application/renewal relating to this pond. Existing on-site runoff flows to the pond as determined by our analysis closely matched those predicted by MLA (see attached computations).

In order to maintain consistency with information relative to the DOE permit, we have assumed that, as a minimum, the existing storage in the pond should be maintained in the proposed drywell. The following criteria were used:

Confirmed elevation of L.P. [illegible]

Stabilized W.S. Elevation (winter)	4.5' MSL
Maximum Allowable W.S. Elevation	10.0' MSL
Maximum Pond Volume Available (winter)	86,000 cu. ft.
Porosity of Proposed Drywell Rockfill	30%

Please note that drain rock porosity was assumed to be 30%. Clean rounded drain rock should retain this 30% void space value for surface loads approaching 2 tons/square foot.

Using this criteria it was found that the minimum area of a proposed drywell facility required to contain the existing pond volume was 52,120 square feet (approximately 230' x 230'). However, the actual available area which can be utilized by an on-site drywell is limited to about 20,000 square feet. Thus, it was decided to obtain further storage by placing lengths of perforated corrugated steel pipe arch horizontally within the drywell. As the effective storage volume in the winter storm months is limited to the horizon between 4.5' MSL and 10.0' MSL, pipes having heights up to 5.5 feet (66" diameter) were studied for possible use within the drywell. The following arrangement was finally chosen:

DRYWELL AREAL DIMENSIONS: 200' x 104'
EFFECTIVE DEPTH OF DRYWELL: 5.5'
PIPE SIZE AND TYPE: 63" x 87" CMP PIPE ARCH
GALVANIZED/PERFORATED 14 GA
PIPE CROSS SECTIONAL AREA: 32.1 SF
PIPE LENGTH: (11) - 200' DISTRIBUTION PIPES
(1) - 104' HEADER
TOTAL PIPE LENGTH: 2,304 LF

TOTAL VOLUME OF EFFECTIVE EXCAVATED AREA:
200' x 104' x 5.5' = 114,400 CU. FT.
PIPE VOLUME: 73958 CU. FT.

RESIDUAL VOLUME: 40,442 CU. FT.
VOID SPACE (30%): 12,132 CU. FT.

TOTAL VOLUME AVAILABLE: 86,090 CU. FT.
= VOLUME AVAILABLE IN PIPE & DRAIN ROCK VOIDS

Figure 1 outlines the proposed storage system layout. Existing seepage occurs only through the sides of the pond above the stabilized water surface elevation. The effective storage area of the proposed system will utilize this same exfiltration horizon. Thus, existing subsurface seepage characteristics, as a minimum, should be maintained. Further improvement of permeability in the pond vicinity can be expected, due to two proposed measures.

First, the pond sides and bottom will be over-excavated and the spoils removed from the area. As the pond has not been scraped clean in several years, the accumulation of fine sediment might explain the low seepage potential demonstrated by the pond in recent years. (Recent soils testing suggests good permeability in other areas of the site.) Secondly, the proposed system will employ several sediment removal mechanisms, including a sediment basin, a manhole designed to settle out fines before flows enter the drywell (see Figure 2), and the pipe system itself, which will allow extensive potential for sediment removal. The stormwater which enters the drywell area through the pipe perforations should contain little, if any, of the particles currently settling in the pond.

SEDIMENTATION BASIN DESIGN

In order to better prevent migration of solids into the system, an oversized, grit-removal basin will be installed upstream of the proposed drywell. The upstream chamber will tie-in to the existing 18" diameter storm drain which discharges into the pond. The chamber was designed to trap sand-sized particles (0.20 mm diameter, 65 mesh) associated with a 10 year storm. Discharge from this sediment basin into a downstream grease trap chamber is controlled by 8" diameter orifices set in the wall between the two chambers. The grease trap area discharges through an 18" diameter inverted elbow back into the existing 18" diameter pipe, leaving behind grease and oils (and particulates) in the second chamber. A manhole will be constructed just upstream of the proposed drywell. From this location, large diameter pipe arch would distribute the flow out into the drywell through perforations.

The design necessitates backwater conditions occurring within upstream portions of the storm sewer system during large storm events. This situation currently exists at the plant during times of high water levels in the pond. We anticipate that backwater effects will occur primarily in the subsurface portion of the conveyance system, including upstream ponding effects within catch basins and manholes. Minor ponding may exist temporarily near "low spots" around catch basins as well.

The grit sedimentation basin will be an open pit, accessible to vehicles which would provide periodic cleaning and maintenance operations. Further sediment removal will occur within the subsurface pipe system, as well as the manhole directly upstream of the drywell.

Structural and/or mechanical means will be employed to minimize effects associated with buoyant forces.

RECOMMENDATIONS AND CONCLUSIONS

In view of the above analysis and following arguments, it is felt that the drainage option best suited to the Ash Grove site is the one employing the existing outlet discharge scheme. The present pond has demonstrated that it can accept flows from a highly developed drainage area and release the stored water gradually out of the system.

It is evident that the detained water has been draining indirectly into the Duwamish Waterway through subsurface porous media. The contribution of these flows on downstream flood levels is essentially negligible. Recommendations relating to the implementation of this alternative include the following:

1. Proper construction and routine maintenance are extremely important for successful infiltration applications. A substantial number of drywells have failed shortly after being built, primarily due to poor construction practices, inadequate field testing or lack of sediment control. Also, a high percentage of infiltration facilities built in the past have failed, primarily because sediment was not filtered or trapped before entering the storage area. <u>The discussion below highlights construction and maintenance procedures that should minimize the risk of premature clogging.</u>

   A. Diversion berms should be placed around the perimeter of the drywell during all phases of construction. Sediment and erosion control plans for the site should be oriented to keep sediment and runoff completely away from the drywell area. Actual construction of the drywell should not begin until after the site is completely stabilized.

   B. Clean, washed 1-3 inch stone aggregate shall be placed in the excavated reservoir in lifts, and <u>lightly</u> compacted with plate compactors to form the course base. Unwashed stone has enough associated sediment to pose a clear risk of clogging at the soil/rock interface.

   C. A few simple observation wells and/or access portals will be installed in the drywell. The observation wells are needed to monitor the performance of the drywell, and are also useful in marking its location. The drain time for a drywell can be measured by placing a graduated dip-stick down the well immediately after a storm and again 24 to 48 hours later.

   D. Post-construction sediment control is critical. It is therefore important that; 1) sediment and erosion controls be inspected to make sure they still work, 2) any vegetated buffer strips are <u>established immediately</u>, preferably by sodding, and 3) if hydroseeding is used, reinforced silt fences or Austin triangles must be placed between the buffer and trench to prevent sediment entry before the buffer becomes fully established.

   E. If bulk storage of aggregate or parking use is anticipated in this area, filter fabric should be placed on top of the drain rock, underlying subgrade to prevent migration of fines into the drywell, according to sources at RZA, Portland. The following table lists acceptable filter fabric materials, as per EPA recommendations.

TABLE 1

Approved Geo-Textiles for Use in Drywell

Mirafi 140-N

Supac 4NP, 4.5NP, 5NP and 8NP

Typar 3401

AMOCO 4545

EXXON Geo-textiles No. 125D, 130D and 150D

TerraTex SD

F. Pipe perforations shall not be less than 5/16" diameter and total area of openings should exceed 3.31 square inches per square foot of pipe surface area.

G. At manholes and tees, perforated pipe should be attached to a 4' stub of non-perforated pipe adjacent to the structure. This will prevent piping at the structure with subsequent soil settlement.

2. Routine Maintenance - It is our understanding that the City of Seattle, will, after plan review, require that a maintenance agreement be drawn up with the owner. Some of the normal maintenance tasks for drywells are detailed below; we can incorporate further City recommendations into the final agreement.

A. Inspection - The drywell should be inspected several times in the first few months of operation, and then annually thereafter. The inspections should be conducted after large storms to check for surface ponding that might indicate local or wide spread clogging. Water levels in the observation well should be recorded over several days to check outflow seepage rates.

B. Sediment Removal - The pre-treatment inlets of the drywell should be checked periodically and cleaned out when sediment depletes more than 10% of available capacity. This can be done manually or by a vacuum pump. Inlet pipes should be checked for clogging and vandalism.

3. Preliminary analysis indicates that the structure may be overtopped in a larger storm event (25, 50 or 100 year event). If an overflow were to occur, it appears that excess flows would accumulate near the north end of the existing pond and would tend to drain northeast, toward the proposed raw material silos. If the City of Seattle is agreeable, we would recommend installing an emergency overflow pipe through the adjacent river bank to prevent on-site ponding damages in the event of a low-frequency, catastrophic-type storm. This overflow should be set above the 100-year flood elevation for the Duwamish Waterway (8.4, NGVD Datum). However, as the majority of the "low spots" on the site are in parking areas, this may be an unnecessary precaution.

It is our understanding that the general tone of the City of Seattle with regards to a drywell arrangement has not been one of approval. There is some justification for this apprehension, as approximately 30% of drywell projects ultimately fail. However, the primary reason for this failure is poor construction practice. If the above mentioned construction guidelines are followed, the storage facility should adequately satisfy the present drainage needs of Ash Grove.

Ultimately, we recommend preparation of a drywell scheme that incorporates the present seepage relationship between the pond and river. Adequate storage space is available within the proposed layout, and if sediment removal is successful, this storage space should provide a reliable detention mechanism.

If you have any questions regarding this study, do not hesitate to contact our office.

Sincerely,

KLEIN CONSULTING ENGINEERS, INC.

Dan Keppen

Dan Keppen

DK:rw

cc: Steve Rinella, Smith & Monroe & Gray

NOTE: [illegible]

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